(12) UK Patent Application (19) GB (11) 2 343 722 (13) A

(43) Date of A Publication 17.05.2000

(21) Application No 9821409.1

(22) Date of Filing 01.10.1998

(71) Applicant(s)
Yau King Choy
Room 13, 19th Floor, Block A, Kornhill Garden,
29 Hong Shing Road, Hong Kong

(72) Inventor(s)
Yau King Choy

(74) Agent and/or Address for Service
Carpmaels & Ransford
43 Bloomsbury Square, LONDON, WC1A 2RA,
United Kingdom

(51) INT CL[7]
F16B 7/04 12/40

(52) UK CL (Edition R)
F2G G24D G24D4 G24D5
E2A AGLD
F2M MC1 ME M223 M243 M274 M276
U1S S1206 S1211

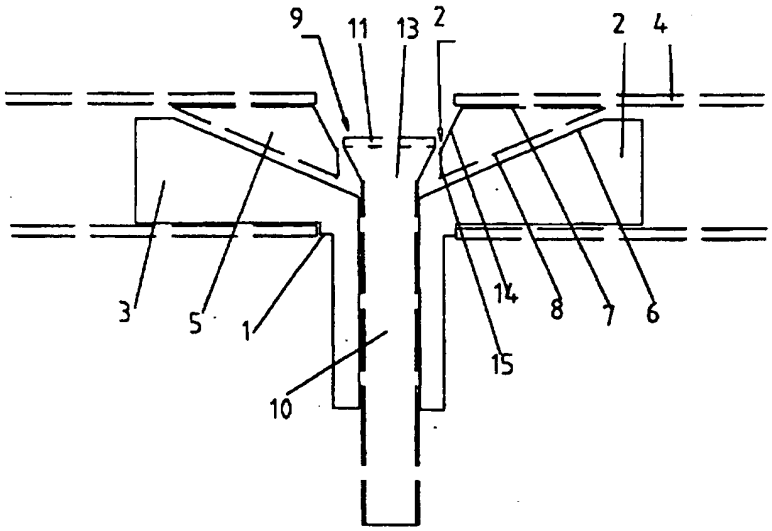
(56) Documents Cited
GB 0992542 A US 4422794 A US 4344719 A

(58) Field of Search
UK CL (Edition R) E2A AGLD , F2G GRX G24D , F2M MC1
INT CL[7] F16B 7/04 12/40 29/00
Online: WPI, EPODOC, PAJIO

(54) Abstract Title
A connector

(57) A connector, for connecting tubes or pipes, comprises insertion means provided with a groove, and a securing member receivable within the groove. The securing member is moveable between a first position, in which the insertion means may be inserted into a hollow portion of a tube or pipe, and a second position, in which the securing member is forced out of the groove against an inner surface of the hollow portion of the tube or pipe, thereby securing the insertion means within the hollow portion of the tube or pipe. Preferably the connector comprises a central body 1 and the insertion means comprises at least one arm 3 extending from the central body for insertion into a hollow portion of the tube or pipe 4 to be connected. The securing means may be in the form of wedge shaped members 5 which may be forced out of the groove 6 by the downwards movement of a screw 9. The connector may be used for releasably connecting tubes or pipes of items of furniture, shelves or metal framework.

Figure 3



GB 2 343 722 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Figure 1

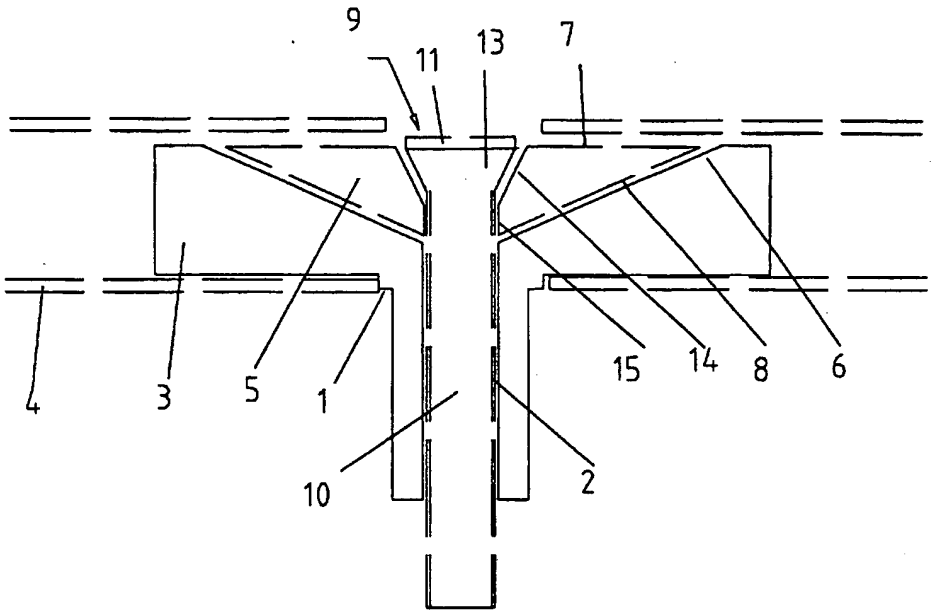


Figure 2

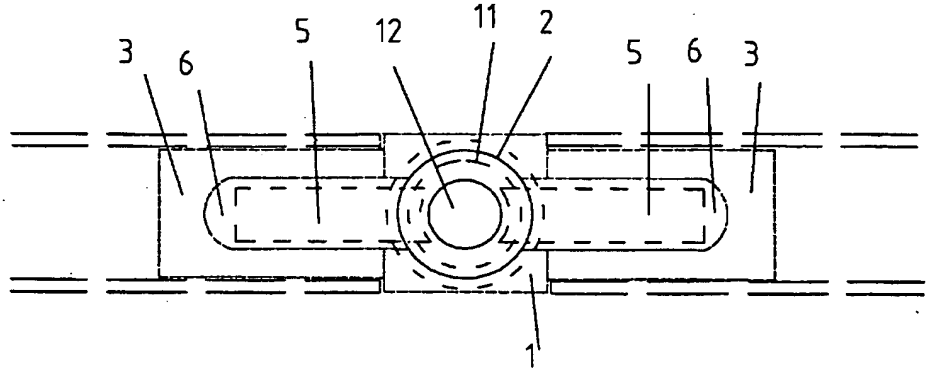


Figure 3

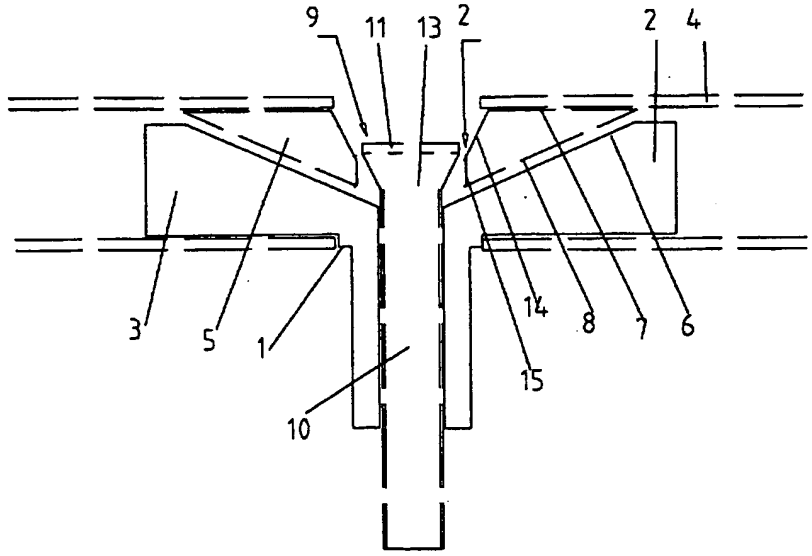


Figure 4

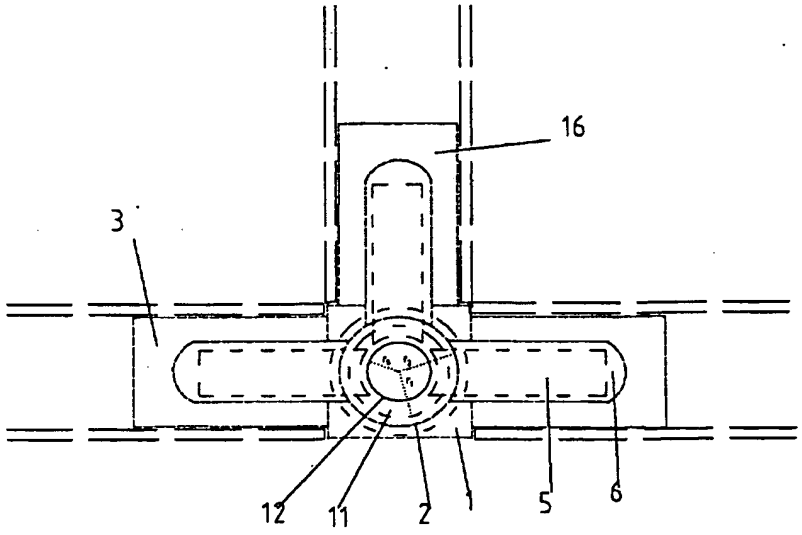


Figure 5

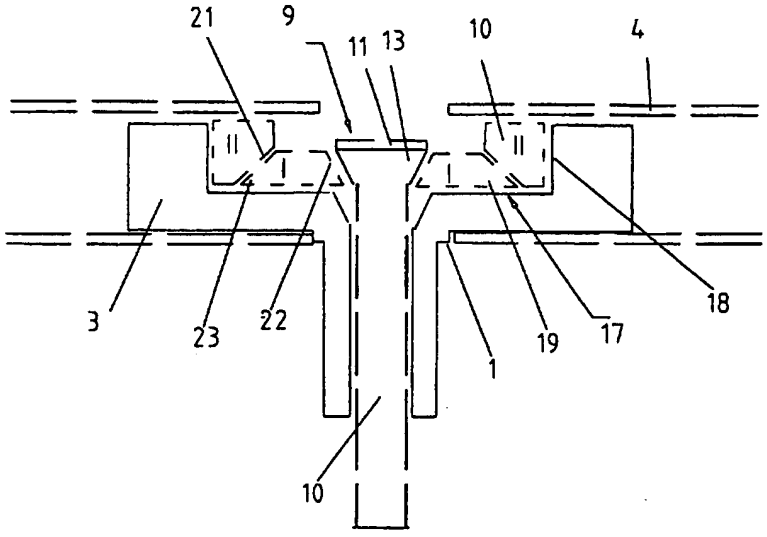


Figure 6

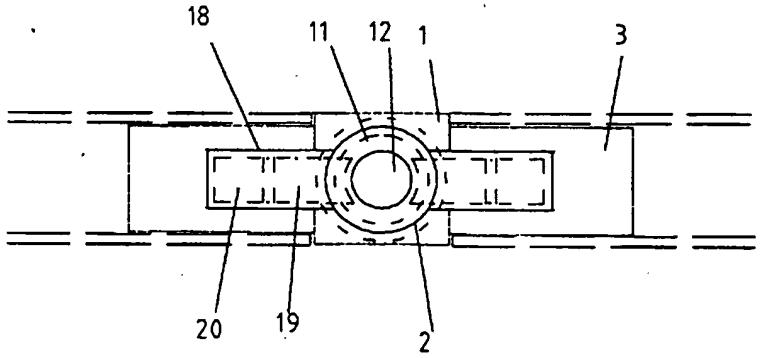


Figure 7

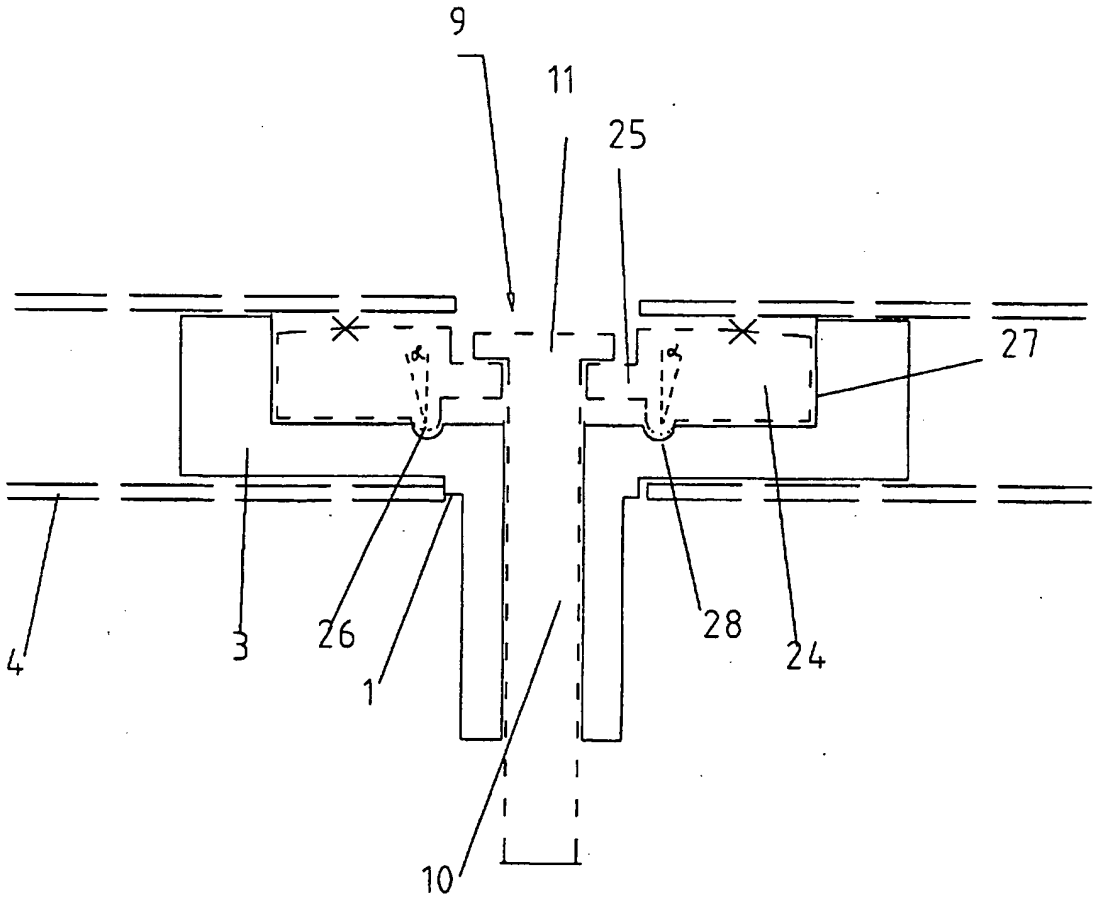


Figure 8

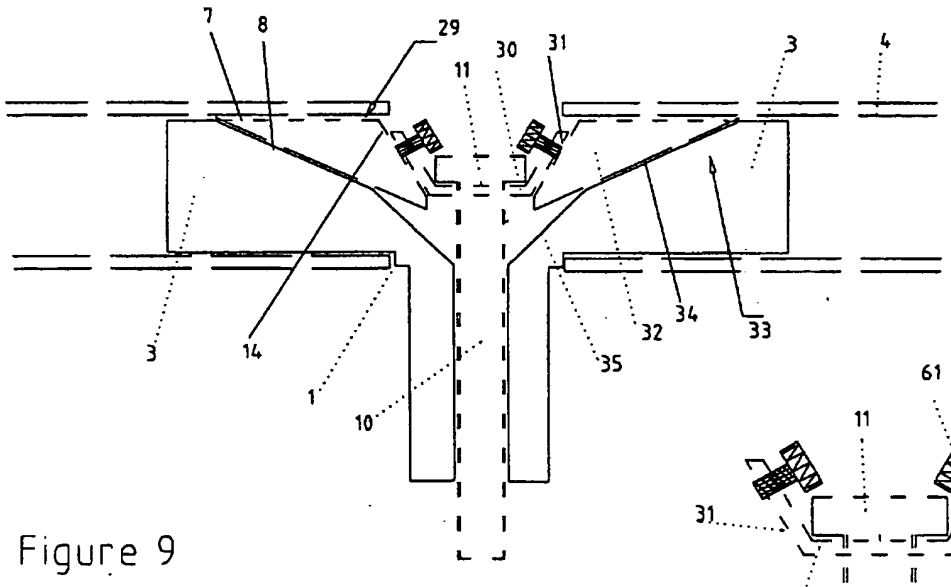


Figure 9

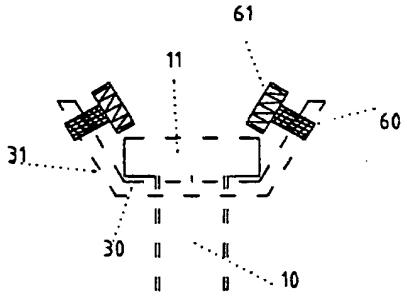
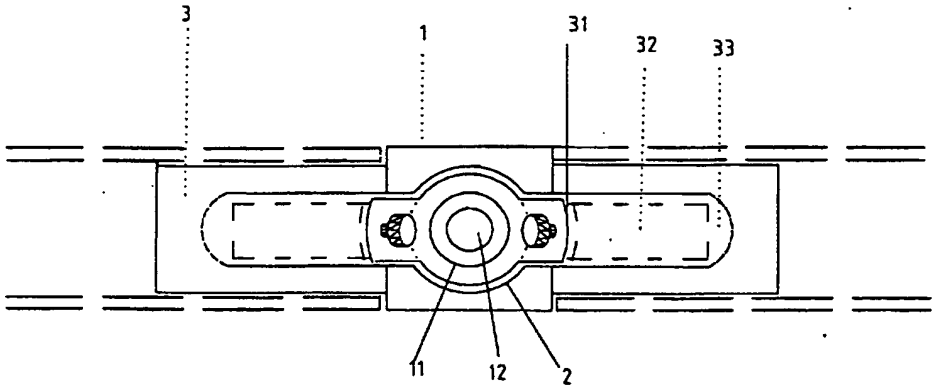


Figure 8A



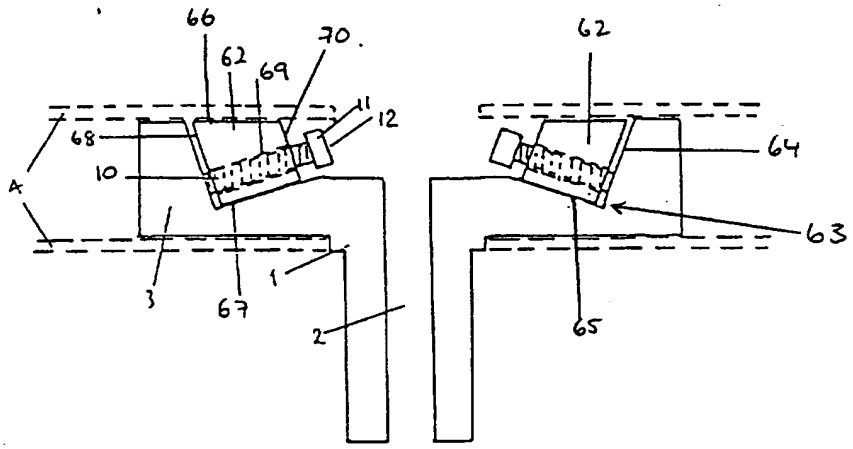


Figure 10

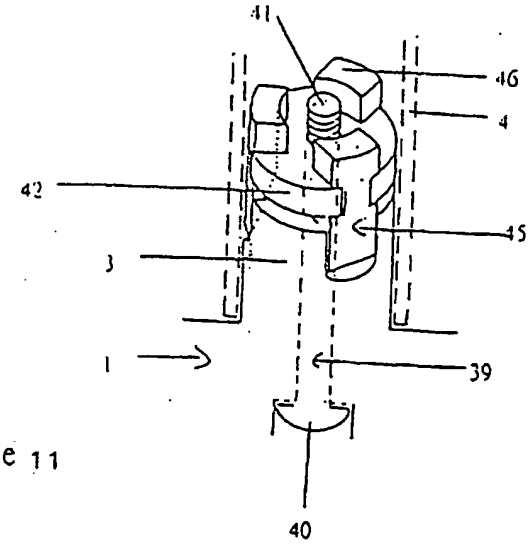


Figure 11

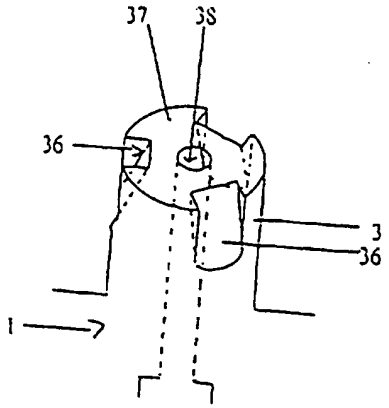


Figure12

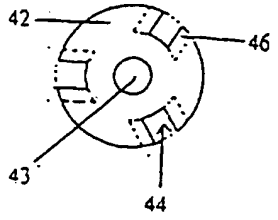


Figure 13A

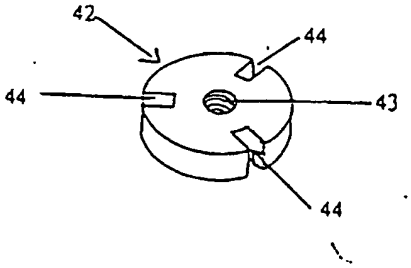


Figure 13B

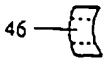


Figure 14A

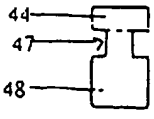


Figure 14B

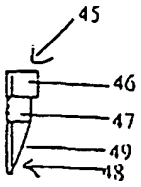


Figure 14C

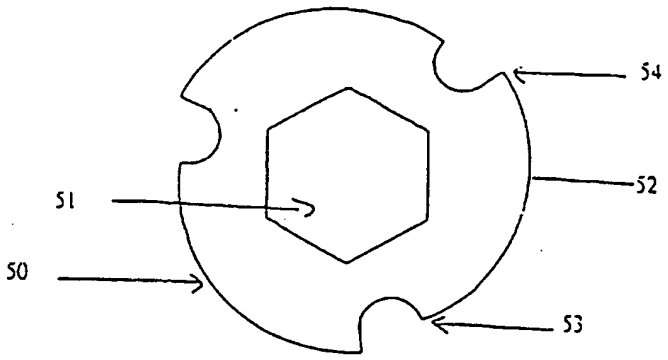


Figure 15

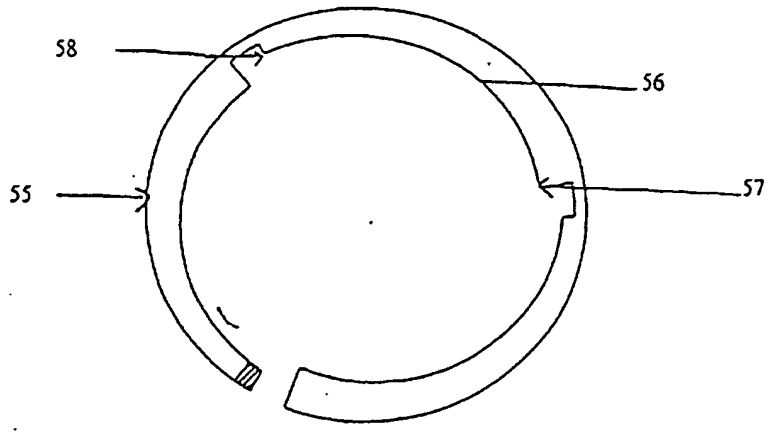
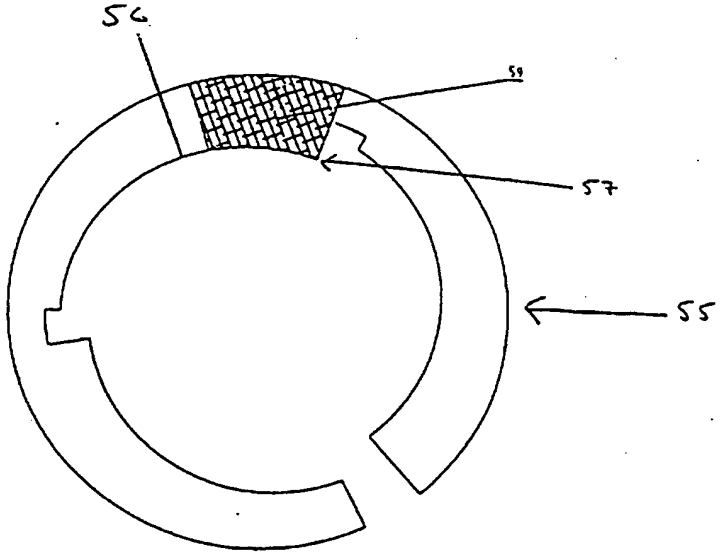


Figure 16

Figure 17A



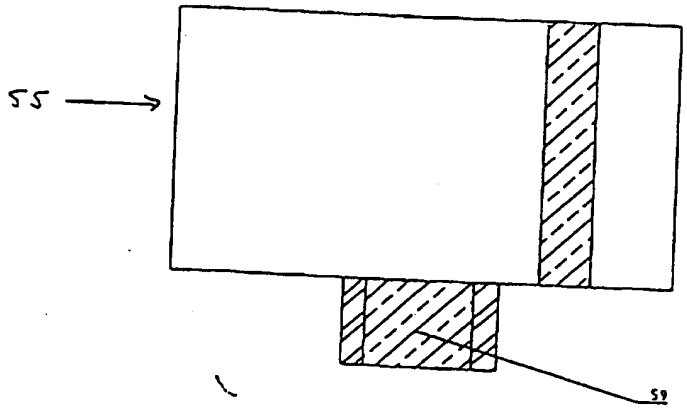


Figure 17B

CONNECTORS FOR TUBES OR PIPES

The present invention relates to connectors for tubes or pipes and, more particularly, to internal connectors for releasably connecting hollow tubes or pipes, from which tubes or pipes items of, for example, furniture, shelves or metal framework may be assembled.

Furniture, shelves and metal framework are commonly assembled using a tubular framework. Various methods exist to connect the tubes of the framework together, often by means of connectors. Such connectors may be divided into two types, those that connect the tubes externally and those that connect the tubes internally.

Of the connectors that connect tubes externally, two major types exist. The first, known as "octopus" connectors, possess a main body from which extend pairs of "fingers", which fit around the tubes to be connected. Often, one of the fingers contains a threaded hole therethrough, in which hole a screw is positioned, the screw being screwable into the hole so as to force a tube positioned between the two projections against the opposite finger so as to hold the tube in place. Such octopus connectors, while releasable, are by their very nature comparatively bulky and tend to extend beyond the frame of the furniture, thus marring the appearance of the furniture and providing the furniture with projections which are potentially dangerous and de-stabilising. Furthermore, those octopus connectors with screw

holes through the fingers necessarily require threaded holes to be machined within the fingers, the machining of which requires precision and is time consuming.

Another common type of external tube connector is the "water-pipe" connector. This type of connector comprises a tube, with an internal diameter slightly larger than the external diameter of the tubes to be connected. The internal surface of the connector has a female screw thread which may be threaded on to male screw threads positioned on the external surface of the tubes to be connected. Whilst this connector is also releasable, it again tends to mar the overall appearance of the furniture and, furthermore, requires special tooling of the connector and tube to provide the male and female screw threads.

Other forms of external connectors for tubes generally comprise sleeves into which a tube may be inserted, the tube and connector having holes therethrough which, when the holes are aligned, receive a screw, bolt, or other fixing means. As with the "water-pipe" connectors, these connectors require special tooling to provide holes therethrough and, furthermore, the tubes to be connected must have corresponding holes machined through the tubes.

Most connectors which fix tubes internally comprise shaped projections which fit snugly within the tubes to be connected. Some comprise male screw-threads on the outer surface of the projections, which male screw-threads are adapted to be screwed into female screw-threads machined on the inside of the tubes. This again means necessary machining of the tubes to form the framework and also requires a certain amount of effort in order to connect the tubes together.

Another type of internal connector is known from GB-A-2205141 (Yau King Choy). This connector comprises a body through which is positioned a screw having a head and a threaded stem. A resiliently deformable member is positioned on the threaded stem and is retained by a nut. The connector is inserted into a tube and is rotated by means of, for example, a screwdriver so that the nut is rotated along the threaded stem towards the body, thus compressing the resiliently deformable member so that the resiliently deformable member bulges outwardly to establish a friction fit on the inner surface of the tube. A side wall of the connector body comprises an aperture for receiving a screw driver or suitable implement for rotating the screw. Although the internal connector of GB-A-2205141 has a number of advantages, it also has the disadvantage that *the securing of the connector by compressing the deformable member is not always easy to operate and needs a long, strong and steady application of force on the head of the screw member. Also,* a separate screw is required for each tube or pipe to be connected.

Other internal connectors known at present are fitted by means of adhesives or are knocked or driven into the insides of the tubes to be connected. Such methods are relatively permanent and the connectors are only releasable with a great deal of difficulty, thus making the completed frames difficult to dismantle and re-assemble elsewhere.

It is an object of the present invention to overcome or at least mitigate one or more of the above mentioned disadvantages of the prior art.

According to the present invention, there is provided a connector for connecting tubes or pipes, which connector comprises insertion means, provided with a groove, and a securing member, receivable within the groove, wherein the

securing member is moveable, in use, between a first position, in which the insertion means may be inserted into a hollow portion of a tube or pipe, and a second position, in which the securing member is forced out of the groove against an inner surface of the hollow portion of the tube or pipe, thereby securing the insertion means within the hollow portion of the tube or pipe. The connector of the present invention is non-bulky, does not mar the appearance of items assembled from tubes or pipes and does not require any special machining of the tubes or pipes themselves so that the connector of the present invention may be used to connect any type of tube or pipe which is standard in the industry. The connector of the present invention is also simple to manufacture, very easy to use and provides a very secure, yet releasable, connection. *Operation of the connector of the present invention is quick, simple, stable and convenient.*

Preferably, the connector comprises a main body and the insertion means comprises an arm extending from the main body suitable for insertion into a hollow portion of a tube or pipe to be connected, the connector being provided with a plurality of said arms for connecting a plurality of said tubes or pipes.

Preferably, the securing members are slideably moveable between the first and second positions.

More preferably, a securing member comprises a first surface which is flush with the insertion means in the first position and which presses against an inner surface of the hollow portion of the tube or pipe in the second position, a second, inclined, surface which is slideable, in use, along a correspondingly inclined surface of the groove and a third surface against which a force is applied, in use, to slide the securing member between the first and second positions.

Alternatively, a securing member comprises a pair of blocks arranged, in use, in the form of an L-shaped member, the L-shaped member being receivable in use, in a correspondingly shaped groove, wherein a first block of each pair of blocks comprises a first surface which is flush with the insertion means when in the first position, and which presses against an inner surface of the hollow portion of the tube or pipe when in the second position, and a second, inclined, surface which is slideable, in use, along a correspondingly inclined surface of the second block of the pair of blocks, the second block of the pair of blocks comprising a third surface against which a force is applied, in use, to cause the securing member to slide between the first and second positions.

Preferably, the connector further comprises a locking member having an elongate stem receivable by a bore provided in the main body and an enlarged portion which acts, in use, against the third surface of a securing member. The connector may be secured and released quickly and easily by means of the locking member and, advantageously, requires only a single locking member for connecting a plurality of tubes or pipes in a variety of different directions.

Preferably, the locking member comprises a nail or screw, the enlarged portion comprising the head of the nail or screw.

Alternatively, the connector further comprises a locking member having an elongate stem which extends, in use, through a bore or channel in the insertion means, one end of the stem, provided with a threaded portion, protruding from a free end of the insertion means, and a disc-shaped member mountable for threaded rotation on the threaded portion adjacent the free end of the insertion

means, the disc-shaped member being suitable for insertion into the hollow portion of a tube or pipe to be connected and wherein the disc-shaped member acts, in use, against the third surface of a securing member.

More preferably, the third surface of a securing member forms part of an extended portion of the securing member, the extended portion of the securing member being held within a slot provided in the disc-shaped member.

Alternatively, the connector further comprises a locking member having an elongate stem receivable by a threaded bore provided in a securing member, the third surface of the securing member forming a wall of the threaded bore and the elongate stem having a threaded portion which acts, in use, against the third surface of the securing member.

Alternatively, the connector further comprises a locking member having an elongate stem with a threaded portion receivable by a bore in a securing member and a threaded nut attached to the securing member between the securing member and an end wall of the groove, wherein rotation of the threaded portion in the threaded nut acts, in use, against a third surface of the securing member.

Instead of being slideably movable between the first and second positions, the securing members may, alternatively, be pivotally movable between the first and second positions.

Preferably, a securing member comprises a convex projection, receivable by a correspondingly concave indentation in the groove to form a pivot

point in the groove, and a lever extending from the securing member against which a force is applied in use, to pivot the securing member between the first and second positions.

Preferably, movement of the locking member in an axial direction causes a securing member to move between the first and second positions. Several types of *tubes or* pipes may, *thus*, be connected by moving only a single locking member in the axial direction of the stem such that connection of tubes or pipes using the connector of the present invention is a quick and effortless procedure.

Instead of the insertion means comprising a connecting arm, the insertion means may, alternatively, comprise a disc-shaped member suitable for insertion into a hollow portion of a tube or pipe to be connected, the groove being defined by a cam surface on the disc-shaped member.

In this case, a securing member, preferably, comprises a flexible belt mountable on the disc-shaped member, the flexible belt having a cam surface on an inner surface thereof which corresponds to the cam surface on the disc-shaped member.

More preferably, the securing member is moved, in use, between the first and second positions by rotating the cam surface of the disc-shaped member, in use, against the corresponding cam surface of the flexible belt.

Also provided by the present invention are a tubular framework comprising a connector as described above and an item of furniture comprising a connector as described above.

According to the present invention, there is also provided a method of releasably securing a connector within *a* hollow portion of *a* tube or pipe to be connected, the connector comprising insertion means, provided with a groove, and a securing member, receivable within *the* groove, which method comprises inserting the insertion means into *a* hollow portion of *a* tube or pipe to be connected, and moving the securing member outwardly from the groove until the securing member *is* forced against the inner surface of the hollow portion of the tube or pipe, thereby securing the insertion means in the hollow portion of the tube or pipe.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, examples of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a schematic cross-sectional view of a first example of a connector according to the present invention, in position in a pair of hollow tubes and in a first configuration;

Figure 2 shows a schematic plan view of the connector of Figure 1;

Figure 3 shows a schematic cross-sectional view of the connector of Figure 1, in position in a pair of hollow tubes and in a second configuration;

Figure 4 shows a schematic plan view of a modified version of the connector shown in Figures 1 to 3;

Figure 5 shows a schematic cross-sectional view of a second example of a connector according to the present invention, in position in a pair of hollow tubes;

Figure 6 shows a schematic plan view of the connector of Figure 5;

Figure 7 shows a schematic cross-sectional view of a third example of *a* connector according to the present invention, in position in a pair of hollow tubes;

Figure 8 shows a schematic cross-sectional view of a fourth example of *a* connector according to the present invention, in position in a pair of hollow tubes;

Figure 8A shows a schematic cross-sectional view of part of the connector of Figure 8;

Figure 9 shows a schematic plan view of the connector of Figure 8;

Figure 10 shows a schematic cross-sectional view of a fifth example of a conductor according to the present invention, in position in a pair of hollow tubes;

Figure *11* shows a schematic part-cross-sectional, perspective view of a sixth example of *a connector according to* the present invention, in position in a hollow tube;

Figure *12* shows a schematic perspective view of a part of the connector of Figure *11*;

Figure *13A* shows a schematic plan view of part of the connector of Figure *11*, with the securing members in their resting positions;

Figure *13B* shows a perspective view of part of the connector of Figure *11*;

Figure *14A* shows a schematic top plan view of a securing member for use in the connector of Figure *11*;

Figure *14B* shows a schematic front plan view of the securing member of Figure *14A*;

Figure *14C* shows a side view of the securing member of Figures *14A* and *14B*;

Figure *15* shows a top plan view of part of a connector *being* a seventh example of the present invention;

Figure *16* shows a top plan view of another part of the connector of Figure *15*;

Figure 17A shows a schematic top plan view of a modified version of the part of the connector shown in Figure 16; and

Figure 17B shows a schematic side view of the modified version of the part of the connector of Figure 17A.

The example of the connector according to the present invention shown in Figures 1 to 3 comprises a central solid body 1 having a central bore 2 extending therethrough from an upper surface of the central body 1 to a lower surface thereof. A pair of cylindrical projections or arms 3 of circular cross-section extend from opposing ends of the central body 1 along an axis which is perpendicular to the central longitudinal axis of the bore 2. *(The cylindrical projections 3 may, alternatively, extend at definitive angles to the central longitudinal axis of the bore 2).* The diameters of the cylindrical projections or arms 3 are slightly smaller than the internal diameters of the hollow tubes or pipes 4 to be connected so that they may be inserted into the hollow tubes or pipes *4* to be connected. The diameter of the central body 1, on the other hand, is preferably substantially the same as the external diameter of the hollow tubes or pipes 4 to be connected, such that, when the hollow tubes or pipes 4 to be connected are in position over the cylindrical projections 3, the central body 1 lies between the ends of the hollow tubes or pipes 4 with the ends of the hollow tubes or pipes 4 abutting the central body 1 and with the outer surface of the central body 1 flush or substantially flush with the outer surfaces of the hollow tubes or pipes 4.

The connector of Figures 1 to 3 further comprises a pair of wedge-shaped securing members 5 which fit into correspondingly shaped grooves 6, one groove 6 being provided in each cylindrical projection 3. The correspondingly shaped grooves 6 in the cylindrical *surfaces of the cylindrical* projections 3 of Figures 1 to 3 slope inwardly, downwardly from the outer cylindrical surfaces of the cylindrical projections 3 into the central bore 2 of the central body 1.

When the wedge-shaped members 5 are in a resting position within the grooves 6 before connection, a first upper surface 7 of each wedge-shaped member 5 lies parallel to and flush with the outer cylindrical surface of each cylindrical projection 3. In addition, a second sliding surface 8 of each wedge-shaped member 5 is inclined along the same plane as the sloping grooves 6 such that, when the wedge-shaped members 5 are in position in the grooves 6 before connection, the second sliding surfaces 8 of the wedge-shaped members 5 lie along the sloping surfaces of the grooves 6 (see Figure 1).

The connector is also provided, in use, with a locking member in the form of a screw 9 which is long enough to extend from one side of the bore 2 to the other. In use, the head of the screw 9 is positioned above the upper end of the central bore 2 and the lower part of the stem 10 of the screw 9 extends below the lower end of the bore 2. A retaining means in the form of a nut (not shown) provided with corresponding internal screw-threads is threaded on to the screw stem 10 below the central bore 2. In practice, another tube or pipe 4 may be placed over the nut (not shown) in order to hide the nut such that the nut will not protrude and mar the item assembled from the tubes and pipes 4. Alternatively, the nut may be replaced by another type of securing device, *for example, one of those described* below.

The head of the screw 9 used in the connectors shown in Figures 1 to 6 of the drawings comprises an upper portion 11 having substantially vertical sides, a groove 12 on the upper surface thereof for insertion of a screwdriver, key or other suitable implement (not shown) and a lower portion with inclined surfaces 13

which slope inwardly, downwardly towards the stem 10. Any other type of conventional or suitable screw may, *alternatively*, be used.

The third surface of each wedge-shaped member 5 comprises an upper abutment surface 14 and a lower indented portion 15. The upper abutment surface 14 is inclined along the same plane as the inclined surfaces 13 of the screw head, and, when the wedge-shaped members 5 are in position in the grooves 6 before connection, the inclined abutment surfaces 14 of the wedge-shaped members 5 lie in close contact with the inclined surfaces 13 of the screw head and the lower indented portions 15 of the wedge-shaped members 5 fit around the stem 10 of the screw 9.

To operate the connector of Figures 1 to 3, the cylindrical projections 3, with the wedge-shaped members 5 flush with the outer cylindrical surfaces of the cylindrical projections 3, are inserted into a pair of appropriately sized hollow tubes or pipes 4 to be connected until the ends of the hollow tubes or pipes 4 abut the central body 1.

A screwdriver, key or other suitable implement (not shown) is placed into the groove 12 in the screw head 11,13 and the screw 9 is rotated such that the head 11,13 moves downwardly into the bore 2, towards the nut (not shown). As the head 11, 13 of the screw 9 moves downwardly, the head 11, 13 bears down upon the abutment surfaces 14 of the wedge-shaped members 5. This forces the wedge-shaped members 5 to slide upwardly and outwardly from the grooves 6 along the sloping surfaces of the grooves 6 until the wedge-shaped members 5 are no longer flush with the outer cylindrical surfaces of the cylindrical projections 3 and are pressed tightly against the inner surfaces of the hollow tubes or pipes 4 to

be connected, between the inner surfaces of the hollow tubes or pipes 4 and the sloping surfaces of the grooves 6, thereby tightly securing the cylindrical projections 3 of the connector within the hollow tubes or pipes 4 (see Figure 3).

In order to release the connector, the screw 9 is simply rotated in the opposite direction, away from the nut (not shown), until the wedge-shaped members 5 slide back into their original resting positions in the grooves 6, with the wedge-shaped members 5 flush with the outer cylindrical surfaces of the cylindrical projections 3. The cylindrical projections 3 can then be quickly and easily pulled out of the hollow tubes or pipes 4.

Figure 4 shows a modified version of the example of the present invention shown in Figures 1 to 3, whereby a third cylindrical projection 16 extends from the central body 1 at right angles to the opposing cylindrical projections shown in Figures 1 to 3, and in the same plane as the opposing cylindrical projections 3 shown in Figures 1 to 3, so that three hollow tubes or pipes 4 may be connected instead of two. Any number of hollow tubes or pipes 4 may be connected in a similar way, *in any combination of different planes and/or angles.*

Figures 5 and 6 show a second example of the present invention. In this example of the present invention, the one piece wedge-shaped members 5 are replaced by two piece L-shaped members 17 and the cylindrical projections 3 are provided with corresponding L-shaped grooves 18, each L-shaped groove 18 having an end surface which is distal from the central bore 2 and substantially perpendicular to the central longitudinal axis of the cylindrical projection 3, and a bottom surface which extends into the central bore 2 from the end surface of the

groove 18 along an axis which is substantially parallel to the central longitudinal axis of the cylindrical projection 3.

When the two piece L-shaped members 17 are in a resting position in the grooves 18 of Figures 5 and 6 before connection, the long arms 19 of the L-shaped members 17 lie along an axis perpendicular to the central longitudinal axis of the bore 2 (parallel to the *central* longitudinal axis of the *corresponding* cylindrical projection 3) and the short arms 20 of the L-shaped members 17 lie remote from the central bore 2 and point upwardly towards the outer cylindrical surfaces of the cylindrical projections 3, with the upper ends of the short arms 20 flush with the outer cylindrical surfaces of the cylindrical projections 3.

The short arm 20 of each two-piece L-shaped member 17 has a rectangular cross-section with a part of a lower corner of the rectangle cut off to form an inclined surface 21 between two sides of the rectangle.

The long arm 19 of each two-piece L-shaped member 17 has a trapezial cross-section having an abutment surface 22 which is inclined along the same plane as the inclined surfaces 13 of the screw head and a sliding surface 23 which is inclined along the same plane as the inclined surface 21 of the short arm 20. When the L-shaped members 17 are in a resting position in the grooves 18 before connection, the abutment surfaces 22 of the long arms 19 lie in close contact with the inclined surfaces 13 of the screw head and the sliding surfaces 23 of the long arms 19 lie along the inclined surfaces 21 of the short arms 20 at the corners of the L-shaped members 17. The lowermost point of the sliding surfaces 23 of the long arms 19 do not extend all the way to the ends of the grooves 18 in the cylindrical

projections 3 and are prevented from doing so by the short arms 20 of the L-shaped members 17.

To operate the connector of Figures 5 and 6, the cylindrical projections 3, with *the upper ends of the short arms 20 of* the L-shaped members 17 flush with the outer cylindrical surfaces of the cylindrical projections 3, are inserted into a pair of appropriately sized hollow tubes or pipes 4 to be connected until the ends of the hollow tubes or pipes 4 abut the central body 1.

A screwdriver, key or other suitable implement (not shown) is placed into the groove 12 in the screw head 11, 13 and the screw 9 is rotated such that the head 11, 13 of the screw 9 moves downwardly towards the nut (not shown). As the head 11, 13 of the screw 9 moves downwardly, the head 11, 13 bears upon the inclined abutment surfaces 22 of the long arms 19 of the L-shaped members 17. This forces the long arms 19 of the L-shaped members 17 away from the screw 9 in the direction of the short arms 20, along an axis perpendicular to the longitudinal axis of the screw 9 *(parallel to the longitudinal axis of the corresponding cylindrical projection 3)* and until the lowermost points of the sliding surfaces 23 of the long arms 19 of the L-shaped members 17 reach the ends of the grooves 18. As the sliding surfaces 23 of the long arms 19 slide along the inclined surfaces 21 of the short arms 20, the short arms 20 of the L-shaped members 17 are forced upwardly out of the grooves 18 in a direction parallel to the central longitudinal axis of the screw 9 *(perpendicular to the longitudinal axis of the corresponding cylindrical projection 3)*. As a result, the short arms 20 of the L-shaped members 17 are no longer flush with the outer cylindrical surfaces of the cylindrical projections 3 and are pressed tightly against the inner surfaces of the hollow tubes or pipes 4 to be connected, between the inner surfaces of the hollow

tubes or pipes 4 and the sliding surfaces 23 of the long arms 19, thereby tightly securing the cylindrical projections 3 of the connector within the hollow tubes or pipes 4.

In order to release the connector, the screw 9 is simply rotated in the opposite direction, away from the nut (not shown), until the L-shaped members 17 slide back into their original resting positions in the grooves 18, with the upper ends of the short arms 20 flush with the outer cylindrical surfaces of the cylindrical projections 3. The cylindrical projections 3 can then be quickly and easily pulled out of the hollow tubes or pipes 4.

Figure 7 shows a third example of the present invention. The example of the present invention shown in Figure 7 differs from the examples of the present invention shown in Figures 1 to 6 in that the one-piece wedge-shaped members 5 and the two-piece L-shaped members 17 are replaced by one-piece blocks 24, which may be circular or rectangular in cross-section. Each block 24 has a finger-like projection *or lever* 25 extending along a first axis and a convex body 26 projecting along a second axis perpendicular to the first axis. Corresponding grooves 27 extending into the central bore 2 are provided in each of the cylindrical projections 3 and each groove 27 has, in the lower surface thereof, a concave indentation 28 corresponding to the convex body 26 on each block 24 such that the concave indentations 28 form pivot points for the blocks 24 in the grooves 27.

When the blocks 24 are in a resting position in the grooves 27 before connection, with the convex bodies 26 of the blocks 24 in the concave indentations 28, the finger-like projections 25 extend towards the edge of the central bore 2 along an axis perpendicular to the central longitudinal axis of the bore 2 *(parallel to*

the central longitudinal axis of the corresponding cylindrical projection 3). In addition, an upper surface of each block 24 lies flush with the outer cylindrical surface of each cylindrical projection 3.

Another difference between the example of the present invention shown in Figure 7 and the examples of the present invention shown in Figures 1 to 6 is that the screw head only comprises the upper portion 11 and not the lower inclined portion 13 of Figures 1 to 6. However, any other type of conventional or suitable screw *or nail* may be used. When the screw 9 of Figure 7 is in position in the central bore 2 of the connector before connection, the head 11 of the screw 9 sits on the finger-like projections 25 of the blocks 24.

To operate the connector shown in Figure 7, the cylindrical projections 3, with the upper surfaces of the blocks 24 flush with the outer cylindrical surfaces of the cylindrical projections 3, are inserted into a pair of appropriately sized hollow tubes or pipes 4 to be connected until the ends of the tubes or pipes 4 abut the central body 1.

A screwdriver, key or other suitable implement (not shown) is placed into the groove 12 in the screw head 11 and the screw 9 is rotated such that the head 11 of the screw 9 moves downwardly towards the nut (not shown). As the head 11 of the screw 9 moves downwardly, the head 11 bears down upon the finger-like projections 25 of the blocks 24 causing the blocks 24 to pivot about the pivot points in the concave indentations 28 in the grooves 27. The ends of the blocks 24 opposite the finger-like projections 25, are consequently forced upwardly out of the grooves 27 so that the blocks 24 are no longer flush with the outer cylindrical surfaces of the cylindrical projections 3 and are pressed tightly against

the inner surfaces of the hollow tubes or pipes 4 to be connected, thereby tightly securing the cylindrical projections 3 of the connector within the hollow tubes or pipes 4.

In order to release the connector, the screw 9 is simply rotated in the opposite direction, away from the nut (not shown), until the screw head 11 is lifted away from the finger-like projections 25 and the blocks 24 can pivot back into their original resting positions in the grooves 27, with the blocks 24 flush with the outer cylindrical surfaces of the cylindrical projections 3. The cylindrical projections 3 can then be quickly and easily pulled out of the hollow tubes or pipes 4.

Figures 8 and 9 show a fourth example of the present invention. The example of the present invention shown in Figures 8 and 9 again differs from the examples shown in Figures 1 to 7. Here, the screw 9 is similar to that used in the example shown in Figure 7. However, in addition, the screw head 11 is provided with a pair of opposing metal plates 29. Each metal plate 29 has a first portion 30 which sits immediately below the screw head 11 and an inclined portion 31 which extends upwardly and outwardly from the screw head 11 to a position above the screw head 11.

The example of the present invention shown in Figures 8 and 9 further employs a pair of securing members 32 which are triangular in cross-section, similar to the wedge-shaped members 5 used in the example shown in Figures 1 to 4, but without the lower indented portions 15. A pair of corresponding grooves 33 which extend into the central bore 2 are provided in the cylindrical projections 3 and are similar to the grooves 6 shown in Figures 1 to 4 except that the grooves 33 are divided into two sections with an upper section 34 of each groove 33 sloping

inwardly, downwardly from the outer cylindrical surface of each cylindrical projection 3 towards a lower section 35 of the groove 33, the lower section 35 of the groove 33, in turn, sloping inwardly, downwardly into the central bore 2 along a steeper gradient than the upper section 34 of each groove 33.

When the triangular-shaped members 32 are in a resting position within the grooves 33 before connection, the first upper surfaces 7 of the triangular-shaped members 32 lie parallel to and flush with the outer cylindrical surfaces of the cylindrical projections 3 and the second sliding surfaces 8 of the triangular-shaped members 32 lie along the upper sections 34 of the sloping grooves 33. In addition, the third abutment surfaces 14 of the triangular-shaped members 32 lie in close contact with the inclined surfaces of the metal plates 29.

To operate the connector shown in Figures 8 and 9, the cylindrical projections 3, with the *upper surfaces of the* triangular-shaped members 32 and *upper* ends of the metal plates 29 flush with the outer cylindrical surfaces of the cylindrical projections 3, are inserted into a pair of appropriately sized hollow tubes or pipes 4 to be connected until the ends of the tubes or pipes 4 abut the central body 1.

A screwdriver, key or other suitable implement (not shown) is placed into the groove 12 in the screw head 11 and the screw 9 is rotated such that the head 11 of the screw 9 moves downwardly towards the nut (not shown). As the head 11 of the screw 9 moves downwardly, the metal plates 29 on the head 11 of the screw 9 bear down upon the abutment surfaces 14 of the triangular-shaped members 32, thereby forcing the triangular-shaped members 32 to slide upwardly and outwardly from the grooves 33 along the upper sections 34 of the sloping

grooves 33, until the triangular-shaped members 32 are no longer flush with the outer cylindrical surfaces of the cylindrical projections 3 and are pressed tightly against the inner surfaces of the tubes or pipes 4 to be connected, between the inner surfaces of the hollow tubes or pipes 4 and the upper sections 34 of the sloping grooves 33, thereby tightly securing the cylindrical projections 3 of the connector within the hollow tubes or pipes 4. The lower steeper sections 35 of the grooves 33 allow the metal plates 29 and screw head 11 to move downwardly into the bore 2 without obstruction.

The metal plate 29 in this example of the present invention may, optionally, be provided with a threaded bore 60 in the inclined portion 31, as shown in Figure 8A, or with a bore 60 in the inclined portion 31 and a threaded nut (not shown) between the inclined portion 31 and the inclined abutment surface 14 of the underlying securing member 32. A small threaded screw 61 is received by the threaded bore 60, or the bore 60 and threaded nut (not shown). The screw 61 in Figure 8A is shown with the stem of the screw 61 flush with the lower surface of the inclined portion 31 of the metal plate 29.

Where the force applied to the metal plates 29 by the screw 9 is insufficient to press the securing member 32 tightly enough against the inner surface of the hollow tube or pipe 4 to ensure a secure connection, rotation of the small screw 61 against the abutment surface 14 of the underlying securing member 32, forces the securing member 32 to slide further along the upper section 34 of the sloping groove 33. The force with which a securing member 32 is pressed against the inner surface of a hollow tube or pipe 4 can, thus, be calibrated in this way, thereby ensuring a tight, yet releasable, connection.

In order to release the tubes or pipes 4, the screw 9 is simply rotated in the opposite direction, away from the nut (not shown), until the triangular-shaped members 32 can slide back into their original resting positions in the grooves 33, with the *upper surfaces of the* triangular-shaped members 32 and *the upper* ends of the metal plates 29 flush with the outer cylindrical surfaces of the cylindrical projections 3. The cylindrical projections 3 can then be quickly and easily pulled out of the hollow tubes or pipes 4.

In the example of the connector shown in Figures 8 and 9, the pair of metal plates 29 may, instead, be replaced by a single metal piece in the form of a truncated cone. Of course, any suitable material other than metal may also be used. Furthermore, the metal plates 29 or metal piece and screw 9 may be replaced by any other appropriate fixing or locking means having an elongate stem 10 *and/or* suitably inclined portions 31, or other enlarged portion of increased diameter, which may be releasably or integrally attached thereto.

The examples of the connectors shown in Figures 7, 8 and 9 have the added advantage that they may be used with ordinary, commercially available, nails, bolts or screws, which do not need to be specially machined.

It should again be noted that any fixing means, preferably comprising a head 11 and elongate stem 10, such as a nail (not shown), may be used in place of the screw 9 and any suitably sized and shaped securing member capable of sliding or pivoting in the grooves of the cylindrical projections 3 may be used in place of the examples of the securing members shown in the accompanying drawings.

Figure 10 shows a fifth example of the present invention. In this example of the present invention, the securing member 62 is in the form of a one-piece member having a trapezial cross-section. The securing member 62 shown in Figure 10 has a cross-section in the form of a right-angled trapezium. The cylindrical projections 3 are provided with correspondingly shaped grooves 63, each groove 63 having an end surface 64 which is distal from the central bore 2 and which, in the case of Figure 10, is inclined away from the central bore 2, at an angle to the central longitudinal axis of the bore 2 and the central longitudinal axis of the corresponding cylindrical projection 3. A lower surface 65 of the groove 63 slopes upwardly from the distal end surface 64 towards the central bore 2 and extends into the central bore 2.

When the securing members 62 are in a resting position within the grooves 63 before connection, a first upper surface 66 of each securing member 62 lies parallel to and flush with the outer cylindrical surface of each cylindrical projection 3. A second sliding surface 67 of each securing member 62 is inclined along the same plane as the lower sloping surface 65 of the groove 63 such that, when the securing members 62 are in position in the grooves 63 before connection, the second sliding surfaces 67 of the securing members 62 lie along the lower sloping surfaces 65 of the grooves 63. In addition, a third surface 68 of each securing member 62, which in Figure 10 is perpendicular to the second sliding surface 67, in inclined along the same plane as the distal end surface 64 of the groove 63 and lies along the distal end surface 64 when in position in the groove 63, before connection.

In contrast to the previous examples, wherein a locking member is provided in the central bore 2 of the central body 1, each securing member 62, in

this example of the present invention is, itself, provided with a threaded bore 69 extending from the third surface 68 of the securing member 62 to the opposing surface 70 of the securing member 62 adjacent the central bore 2, along an inclined axis which is parallel to the lower sloping surface 65 of the groove 63. The locking member in the form of a screw 9, or other suitable device, having a head 11 and a threaded stem 10, is, thus, in this example of the present invention, provided in the threaded bore 69 of each securing member 62, with the head 11 of the screw 9 provided, in use, adjacent the central bore 2, and with the threaded stem 10 of the screw 9 abutting against the distal end surface 64 of the groove 63.

To operate the connector of this example of the present invention, the cylindrical projections 3, with the *upper surfaces 66 of the* securing members 62 flush with the outer cylindrical surfaces of the cylindrical projections 3, are inserted into a pair of appropriately sized hollow tubes or pipes 4 to be connected until the ends of the hollow tubes or pipes 4 abut the central body 1.

A screwdriver, key, or other suitable implement (not shown), is used to rotate each screw *9* into the threaded bore *69* of the corresponding securing member *62*, towards the distal end surface *64* of the corresponding groove *63*. Because the *threaded* stem *10* of the screw *9* abuts against the distal end surface *64* of the groove *63*, with rotation of the securing member *62* restricted by the groove *63*, rotation of the screw *9* in each case causes the securing member *62* to move along the *threaded* stem *10* of the screw *9* towards the head of the screw *9*. This forces the securing members *62* to slide upwardly and outwardly from the grooves *63*, along the *lower* sloping surfaces *65* of the grooves *63*, until the securing members *62* are no longer flush with the outer cylindrical surfaces of the cylindrical projections 3 and are pressed tightly against the inner surfaces of the

hollow tubes or pipes 4 to be connected, between the inner surfaces of the hollow tubes or pipes 4 and the *lower* sloping surfaces *65* of the grooves *63*, thereby tightly securing the cylindrical projections 3 of the connector within the hollow tubes or pipes 4.

In order to release the connector of this example of the present invention, each screw *9* is simply rotated in the opposite direction, away from the distal end surfaces *64* of *the* grooves *63*, until the securing members *62* slide back into their original resting positions in the grooves *63*, with the securing members *62* flush with the outer cylindrical surfaces of the cylindrical projections 3. The cylindrical projections 3 can then be quickly and easily pulled out of the hollow tubes or pipes 4.

Each of the securing members 62 in this example of the present invention may, alternatively, be provided with a bore 69 parallel to the lower sloping surface 65 of the corresponding groove 63 and a threaded nut (not shown) adhered to the third surface 68 of the securing member 62 and positioned between the third surface 68 of the securing member 62 and the distal end surface 64 of the corresponding groove 63. Rotation of the screw 9 in the threaded nut (not shown) operates in the same way as described above, i.e. rotation of the screw towards the distal end surface 64 of the groove 63 in each case causes the securing members 62 to be forced upwardly and outwardly from the grooves 63 until they are pressed tightly against the inner surfaces of the hollow tubes or pipes 4, and rotation of the screw 9 away from the distal end surface 64 of the groove 63 in each case allows the securing members 62 to slide back into their original resting positions in the grooves 63, with the upper surfaces 66 of the securing members 62 flush with the outer cylindrical surfaces of the cylindrical projections 3.

Figures *11* to *14* show a sixth example of the present invention. In this example, the grooves in the cylindrical projections 3 do not extend into a central bore 2 of the central body 1, as in Examples 1 to *5* of the present invention. Instead, a plurality of wedge-shaped grooves 36 are provided around the circumference of each cylindrical projection 3, at the free end of each cylindrical projection 3, the wedge-shaped grooves 36 extending inwardly, downwardly from the outer cylindrical surface of each cylindrical projection 3 into the free, flat end surface 37 of each cylindrical projection 3.

In addition, an elongate bore 38 is provided through the centre of each cylindrical projection 3, extending from one end of the cylindrical projection 3 to the other. Thus, rather than providing a locking member 9 through a central bore 2 of the central body 1 *as in the previous examples*, a locking member in the form of a screw 39, or other suitable device, is instead, provided in each central bore 38 of the cylindrical projections 3, with the head 40 of the screw 39 adjacent the central body 1 and the stem 41 extending out of the flat end surface 37 of the cylindrical projection 3. *The locking member may, alternatively, extend along an open channel (not shown) provided along the length of the cylindrical projection 3.*

The protruding end of the screw stem 41 is threaded and each has a disc-shaped member 42 mounted thereon. The disc-shaped member 42 is provided with a correspondingly threaded bore 43 through the centre thereof and has substantially the same diameter as the cylindrical projection 3 so that the disc-shaped member 42 may be inserted into the hollow portion of a tube or pipe 4 to be connected at the same time as the cylindrical projection 3.

The outer circumference of the disc-shaped member 42 is provided with a plurality of slots 44 formed therein, and extending from one end surface of the disc-shaped member 42 to the other, at positions corresponding to the plurality of wedge-shaped grooves 36 around the circumference of each cylindrical projection 3. In the example shown in Figures *11* to *14* of the accompanying drawings, there are three such slots 44 in the disc-shaped member 42 and three corresponding wedge-shaped grooves in the cylindrical projection 3.

Each slot 44 of the disc-shaped member 42 holds a securing member 45. Each securing member 45 comprises a curved head portion 46, a restricted neck portion 47 and a curved wedge-shaped portion 48 corresponding to the wedge-shaped grooves 36 around the outer circumference of the cylindrical projections 3. Each wedge-shaped portion 48 has an inclined surface 49. The restricted neck portions 47 of the securing members 45 fit within the slots 44 in the disc-shaped member 42 and movement of the securing members 45 within the slots 44, in the axial direction of the disc-shaped member 42, is restricted by the larger head 46 and wedge-shaped portion 48 of the securing members 45.

When the securing members 45 are in a resting position within the slots 44 of a disc-shaped member 42 *before connection*, with the disc-shaped member 42 threaded on to the protruding end of a screw stem 41, *the inclined surfaces 49 of the wedge-shaped portions 48, which are inclined in the same plane as the sloping surfaces of the wedge-shaped grooves 36, lie along the sloping surfaces of the wedge-shaped grooves 36, and* the outermost curved surface of each securing member 45 lies concentrically and flush with the outer circumference of the disc-shaped member 42 and the outer cylindrical surface of the cylindrical projection 3. *In this position, there is a small gap between the flat end surface 37 of the*

cylindrical projection 3 and the adjacent end surface of the disc-shaped member 42, and the head portion 46 of each securing member 45 *lies* against *the opposite* end surface of the disc-shaped member 42.

To operate the connector of Figures *11* to *14*, each cylindrical projection 3, with the securing members 45 flush with the outer circumference of the disc-shaped member 42 and the outer cylindrical surface of the cylindrical projection 3, is inserted into an appropriately sized hollow tube or pipe 4 to be connected until the end of the hollow tube or pipe 4 abuts the central body 1.

A screwdriver, key, or other suitable implement (not shown) is used to rotate the screw 39 until the disc-shaped member 42 on the threaded end of the screw stem 41 is rotated towards the flat end surface 37 of the corresponding cylindrical projection 3, thereby *closing the gap between the flat end surface 37 of the cylindrical projection 3 and adjacent end surface of the corresponding disc-shaped member 42, and* forcing the wedge-shaped portions 48 of the securing members 45 to slide outwardly from the wedge-shaped grooves 36 along the sloping surfaces of the wedge-shaped grooves 36, radially *outwards from* the slots 44 in the disc-shaped member 42, until the curved outermost surfaces of the securing members 45 are no longer flush with the outer circumference of the disc-shaped member 42 and outer cylindrical surface of the cylindrical projection 3. At this point, the securing members 45 are pressed tightly against the inner surface of the hollow tube or pipe 4 to be connected, between the inner surface of the hollow tube or pipe 4 and the sloping surfaces of the wedge-shaped grooves 36, thereby tightly securing the cylindrical projection 3 of the connector within the hollow tube or pipe 4.

In order to release the connector of this example of the present invention, the screw 39 is simply rotated in the opposite direction, until the disc-shaped member 42 moves away from the flat end surface 37 of the cylindrical projection 3, so that the securing members 45 move back into their original resting positions in the wedge-shaped grooves 36 *and slots 44 of the disc-shaped member 42*, with the outermost curved surfaces of the securing members 45 flush with the outer circumference of the disc-shaped member 42 and the outer cylindrical surface of the cylindrical projection 3. The cylindrical projection 3 can then be quickly and easily pulled out of the hollow tube or pipe 4.

It is envisaged that this example of the present invention may *also* be used in combination with any of Examples 1 to 4 to connect a further tube or pipe 4 to the central body 1 in the axial direction of the locking member 9. For example, a central body 1 of the connector of any one of Examples 1 to 4 may be provided with a further cylindrical projection 3 *according to Example 6* along the central longitudinal axis of the central bore 2. In this case, the central bore 2 extends through the further cylindrical projection 3 and the screw 9 of any one of Examples 1 to 4 is provided to extend the entire length thereof. The disc-shaped member 42 and securing members 45 *may* then *be* used to replace the retaining nut (not shown) on the protruding end of the screw 9 so that a further tube or pipe 4 may quickly and easily be secured to the connector in this way. The screw head 11, 13 of the screw 9 still functions in the same way as in Examples 1 to 4 of the present invention, so that it can again be seen that a single locking member may be used to connect a plurality of tubes or pipes 4 in a variety of different directions.

Figures *15* and *16* show a seventh example of the present invention. In this example of the present invention, each cylindrical projection 3 is provided with

an open channel or central bore (not shown) for receiving a locking member again in the form of a screw or other suitable device (not shown). *The end of each* screw, again, protrudes from the free flat end surface 37 of the cylindrical projection 3 and has a disc-shaped member 50 mounted on the stem of the screw in the same way as Example 6 of the present invention.

In this example of the present invention, however, the *protruding end of the* screw stem is provided, both with a threaded portion (not shown), and an enlarged portion of polygonal cross-section (not shown) *adjacent the threaded portion,* between the threaded portion and the screw head. This enlarged portion of polygonal cross-section fits through a correspondingly shaped hole 51 in the disc-shaped member 50 such that the disc-shaped member 50 may be fixed on to the enlarged portion of polygonal cross-section so as to rotate therewith.

A retaining nut (not shown) may further be provided on the threaded portion of the screw stem so as to prevent axial movement of the disc-shaped *member* 50 along the portion of polygonal cross-section.

The *disc-shaped member 50, thus, forms the insertion means in this example of the present invention and the* grooves in this example of the present invention, in further contrast to the previous examples of the present invention, are defined by a plurality of cam surfaces 52 on the outer circumference of the disc-shaped member 50. The disc-shaped member 50 shown in Figure *15* comprises three such cam surfaces 52, each cam surface 52 extending from a first position 53 to a second position 54, the second position 54 being at a greater distance from the centre of rotation of the disc-shaped member 50 than the first position 53. A flexible band or belt 55 (see Figure *16*) having a cylindrical outer surface and three

cam surfaces 56 on the inner circumference thereof is mounted on the disc-shaped member 50. Each cam surface 56 on the outer belt 55 extends from a first position 57 to a second position 58, the second position 58 again being at a greater distance from the centre of rotation of the belt 55 than the first position 57. The three cam surfaces 56 on the inner circumference of the outer belt 50, thus, correspond to the three cam surfaces 52 on the outer circumference of the disc-shaped member 50 so that, by rotating the cam surfaces 52 of the disc-shaped member 50 against the cam surfaces 56 of the belt 55, different diameters of the cylindrical belt 55 about the disc-shaped member 50 may be achieved.

Thus, as can be seen from Figures *15* and *16*, if the cam surfaces 56 of the belt 55 are arranged on the cam surfaces 52 of the disc-shaped member, with the first positions 57 of the belt 55 aligned with the first positions 53 of the disc-shaped member 50 and the second positions 58 of the belt 55 aligned with the second positions 54 of the disc-shaped member 50, a combined structure of minimum diameter will be obtained. By then rotating the disc-shaped member 50 until the first positions 57 of the belt 55 *are* aligned with the second positions 54 of the disc-shaped member 50, a combined structure of maximum diameter will be obtained.

To operate the example of the connector shown in Figures *15* and *16*, the flexible belt 55 is rotated about the disc-shaped member 50 until a position of minimum diameter is reached, as explained above, and the combined structure is then inserted into an appropriately sized hollow tube or pipe 4 to be connected.

A screwdriver, key or other suitable implement (not shown) is then used to rotate the disc-shaped member 50 by means of the screw so that the cam

surfaces 52 on the disc-shaped member 50, rotate against the corresponding cam surfaces 56 on the belt 55, thereby forcing the cam surfaces 56 of the belt 55 to slide over the cam surfaces 52 of the disc-shaped member 50, until a position of maximum diameter is reached, as explained above. At this point, the outer cylindrical surface of the belt 55 is pressed tightly against the inner surface of the hollow tube or pipe 4 to be connected, between the inner surface of the hollow tube or pipe 4 and the cam surfaces 52 of the disc-shaped member 50, thereby tightly securing, by way of a friction fit, the cylindrical projection 3 within the hollow tube or pipe 4.

Figures 17A and 17B show a modified version of the flexible belt 55 of Figure 16. In this version, the flexible belt 55 is provided with a small, stabilising, tail extension 59 which may be fitted into a corresponding slot in the insertion means (not shown). The tail extension 59 is in the form of a depending axial extension of one of the cam surfaces 56 on the inner circumference of the belt 55 (at the first position 57), this axial extension being flush with at least the inner circumferential surface of the belt 55. The tail extension 59 serves to prevent the belt 55 from slipping on the inner surface of the hollow tube or pipe 4, which helps to force the cam surfaces 56 of the belt 55 to slide over the corresponding cam surfaces 52 of the disc-shaped member 50 as the screw (not shown) is rotated so that the belt 55 is pressed tightly against the inner surface of the hollow tube or pipe 4 to be connected.

In order to release the connector of this example of the present invention, the screw is simply rotated in the opposite direction so that the cam surfaces 56 of the belt 55 slide back over the cam surfaces 52 of the disc-shaped

member 50 into a position of minimum diameter. The cylindrical projection 3 can then be quickly and easily pulled out of the hollow tube or pipe 4.

This example of the present invention has the advantage that it may be used to connect tubes or pipes 4 of various different shapes, for example, tubes or pipes of square or hexagonal cross-section. The outer surface of the belt 55 may be formed to have, for example, a square or hexagonal cross-section rather than a cylindrical cross-section as shown in Example 7 or, alternatively, the belt 55 may be formed from an inner and outer belt (not shown). In the latter *case*, the inner belt may be similar to the belt 55 of Example 7 of the present invention, whilst the outer belt (not shown) *may* have a cylindrical inner surface to fit around the cylindrical outer surface of the inner belt and an outer surface of the same shape as the tube or pipe 4 to be connected.

It is also envisaged that Example 7 of the present invention may be used in combination with, for example, any of Examples 1 to 4 of the present invention to connect a further tube or pipe 4 to the central body 1 along the axial direction of the locking member 9. For example, the screw 9 and retaining nut (not shown) in Examples 1 to 4 of the present invention may be replaced with a screw, disc-shaped member 50 and flexible belt 55 of Example 7 of the present invention. In this case, the head of the screw in Example 7 of the present invention would function in the same way as the screw head 11, 13 of Examples 1 to 4, such that it can again be seen that a single locking member may be used to connect a plurality of tubes or pipes 4 in a variety of different directions.

In the case of all the above-described examples, it is envisaged that more than two cylindrical projections 3 may extend from the same central body 1

(for example, as shown in Figure 4) so that a user may connect any number of hollow tubes or pipes 4 together, either perpendicularly to each other or at a variety of different angles and/or in a variety of different planes. Furthermore, the cylindrical projections 3 may be formed integrally with the central body 1 or may be releasably attached thereto, such that the same connector may be used to connect a varying number of hollow tubes or pipes 4, as desired. *The connectors of the present invention may be appropriately adapted to connect tubes or pipes of any cross-sectional shape.*

It is also envisaged that any two or more examples of the present invention may be used in combination in the same connector. For example, the securing members and correspondingly shaped grooves of Example 1 could be used in the same connector as the securing members and correspondingly shaped grooves of any one or more of Examples 2 to 5 of the present invention, or in combination with *any one or more of* the devices of Examples 6 or 7 of the present invention, as *described above.*

Although cylindrical projections 3 of different diameters will generally be required for connecting tubes or pipes 4 of different diameters in order to achieve a secure connection, in some circumstances, cylindrical projections 3 of the same diameter may be used to connect tubes or pipes 4 of different diameters, by pushing the securing members out of the grooves to varying extents.

The connectors of the present invention are, thus, extremely useful in quickly and releasably connecting pipes or tubes 4 in a tubular framework for use in, for

example, assembling items of furniture or shelves (not shown) and also have the advantage that they do not require any special moulding or machining of the tubes or pipes 4 to be connected. *It is also envisaged that the connectors of the present invention may be suitably adapted to connect a tube or pipe 4 to a piece of apparatus other than another tube or pipe 4.*

The connectors of the present invention are of simple design, which do not require complex tooling, are non-bulky, and provide secure, internal connections which do not mar the appearance of an assembled item, or cause a dangerous or destabilising obstruction. The connectors may be made of metal or any other suitable material and, of course, may be used to connect tubes or pipes 4 made of metal or any other suitable material. Furthermore, according to certain aspects of the present invention, only a single locking member or screw is required for connecting a plurality of tubes or pipes 4 such that a single screwing or unscrewing action can connect or disconnect, a plurality of tubes or pipes quickly and easily, and with minimum effort on the part of the user.

CLAIMS

1. A connector for connecting tubes or pipes, which connector comprises insertion means, provided with a groove, and a securing member, receivable within the groove, wherein the securing member is moveable, in use, between a first position, in which the insertion means may be inserted into a hollow portion of a tube or pipe, and a second position, in which the securing member is forced out of the groove against an inner surface of the hollow portion of the tube or pipe, thereby securing the insertion means within the hollow portion of the tube or pipe.

2. A connector according to Claim 1, wherein the connector comprises a main body and the insertion means comprises an arm extending from the main body suitable for insertion into a hollow portion of a tube or pipe to be connected, the connector being provided with a plurality of said arms for connecting a plurality of said tubes or pipes.

3. A connector according to Claim 2, wherein the plurality of arms are arranged in a single plane.

4. A connector according to Claim 2, wherein the plurality of arms are arranged in a plurality of planes.

5. A connector according to any one of Claims 2 to 4, wherein the securing members are slideably moveable between the first and second positions.

6. A connector according to Claim 5, wherein a securing member comprises a first surface which is flush with the insertion means in the first position, and which presses against an inner surface of the hollow portion of the tube or pipe in the second position, a second, inclined, surface which is slideable, in use, along a correspondingly inclined surface of the groove and a third surface against which a force is applied, in use, to slide the securing member between the first and second positions.

7. A connector according to Claim 6, wherein the securing member is wedge-shaped and is receivable by a correspondingly shaped groove.

8. A connector according to Claim 6, wherein the securing member has a triangular cross-section and is receivable by a correspondingly shaped groove.

9. A connector according to Claim 6, wherein the securing member has a trapezial cross-section and is receivable by a correspondingly shaped groove.

10. A connector according to Claim 5, wherein a securing member comprises a pair of blocks arranged, in use, in the form of an L-shaped member, the L-shaped member being receivable, in use, in a correspondingly shaped groove, wherein a first block of each pair of blocks comprises a first surface which is flush with the insertion means in the first position, and which presses against an inner surface of the hollow portion of the tube or pipe in the second position, and a second, inclined, surface which is slideable, in use, along a correspondingly inclined surface of the second block of the pair of blocks, the second block of the pair of blocks comprising a third surface against which a force is applied, in use, to cause the securing member to slide between the first and second positions.

11. A connector according to any one of Claims 6 to 10, further comprising a locking member having an elongate stem receivable by a bore provided in the main body and an enlarged portion which acts, in use, against the third surface of a securing member.

12. A connector according to Claim 11, wherein the locking member comprises a nail or screw, the enlarged portion comprising the head of the nail or screw.

13. A connector according to Claim 12, wherein the third surface of a securing member is inclined and wherein the head of the nail or screw has an inclined surface corresponding to the third, inclined, surface of the securing member.

14. A connector according to Claim 12, wherein the third surface of a securing member is inclined and wherein the head of the nail or screw comprises a plate mountable thereon, the plate having an inclined surface corresponding to the third, inclined, surface of the securing member.

15. A connector according to Claim 14 which further comprises a threaded screw receivable by a threaded bore in the plate, or receivable by a bore in the plate and a threaded nut between the plate and the third, inclined surface of the securing member, wherein rotation of the screw, in use, against the third, inclined surface of the securing member adjusts the force with which the securing member is pressed against the inner surface of the hollow portion of the tube or pipe in the second position.

16. A connector according to any one of Claims 11 to 15, wherein the groove extends into the bore.

17. A connector according to any one of Claims 6 to 10, further comprising a locking member having an elongate stem which extends, in use, through a bore or channel in the insertion means, one end of the stem, provided with a threaded portion, protruding from a free end of the insertion means, and a disc-shaped member mountable for threaded rotation on the threaded portion adjacent the free end of the insertion means, the disc-shaped member being suitable for insertion into the hollow portion of a tube or pipe to be connected and wherein the disc-shaped member acts, in use, against the third surface of a securing member.

18. A connector according to Claim *17*, wherein the third surface of the securing member forms part of an extended portion of the securing member, the extended portion of the securing member being held within a slot provided in the disc-shaped member.

19. A connector according to Claim 17 or 18, wherein the groove is provided at the free end of the insertion means.

20. A connector according to any one of Claims 6 to 10, further comprising a locking member having an elongate stem receivable by a threaded bore provided in a securing member, the third surface of the securing member forming a wall of the threaded bore and the elongate stem having a threaded portion which acts, in use, against the third surface of the securing member.

21. A connector according to any one of Claims 6 to 10, further comprising a locking member having an elongate stem with a threaded portion receivable by a bore in the securing member and a threaded nut attached to the securing member, between the securing member and an end wall of the groove, wherein rotation of the threaded portion in the threaded nut acts, in use, against a third surface of the securing member.

22. A connector according to any one of Claims 2 to 4, wherein a securing member is pivotally moveable between the first and second positions.

23. A connector according to Claim *22*, wherein a securing member comprises a convex projection, receivable by a correspondingly concave indentation in the groove to form a pivot point in the groove, and a lever extending from the securing member against which a force is applied, in use, to pivot the securing member between the first and second positions.

24. A connector according to Claim *23*, further comprising a locking member having an elongate stem receivable by a bore provided in the main body of the connector and an enlarged portion which acts, in use, against the lever of a securing member.

25. A connèctor according to any one of Claims 11 *to 21 or 24*, wherein movement of the locking member in an axial direction causes a securing member to move between the first and second positions.

26. A connector according to *any one of* Claims 11 *to 16* or *24*, wherein the locking member further comprises means for retaining a securing member in the second position.

27. A connector according to Claim *26*, wherein the locking member comprises a screw and the retaining means comprises a nut threadedly engaged to the screw.

28. A connector according to Claim 1, wherein the insertion means comprises a disc-shaped member, suitable for insertion into a hollow portion of a tube or pipe to be connected, the groove being defined by a cam surface on the disc-shaped member.

29. A connector according to Claim *28*, wherein a securing member comprises a flexible belt mountable on the disc-shaped member, the flexible belt having a cam surface on an inner surface thereof which corresponds to the cam surface on the disc-shaped member.

30. A connector according to Claim *29*, wherein the securing member is moved, in use, between the first and second positions by rotating the cam surface of the disc-shaped member, in use, against the corresponding cam surface of the flexible belt.

31. A connection according to Claim 30, wherein the disc-shaped member is mounted for rotation with a screw, and wherein rotation of the cam surface of the disc-shaped member against the corresponding cam surface of the flexible belt is caused, in use, by rotation of the screw.

32. A connector according to *any one of Claims 29 to 31*, wherein the disc-shaped member and flexible belt comprise a plurality of corresponding cam surfaces.

33. A connector according to any *one* of Claims *29 to 32*, wherein an outer surface of the flexible belt is shaped to correspond to a shaped hollow portion of a tube or pipe to be connected.

34. A connector according to any one of Claims 29 to 33, wherein the flexible belt is provided with a depending tail.

35. A connector, substantially as hereinbefore described, with reference to and as shown in Figures 1 to 3, 4, 5 and 6, 7, 8, 9, 10, *11 to 14, 15 and 16, or 17* of the accompanying drawings.

36. A tubular framework comprising a connector according to any one of Claims 1 to *35*.

37. A tubular framework substantially as hereinbefore described.

38. An item of furniture comprising a connector according to any one of Claims 1 to *35* or a tubular framework according to Claim *36 or 27*.

39. An item of furniture substantially as hereinbefore described.

40. A method of releasably securing a connector within *a* hollow portion of *a* tube or pipe to be connected, the connector comprising insertion means, provided with a groove, and a securing member, receivable within *the* groove, which method comprises inserting the insertion means into *a* hollow portion of *a* tube or pipe to be connected and moving the securing member outwardly from the groove until the securing member *is* forced against the inner surface of the hollow portion of the tube or pipe, thereby securing the insertion means in the hollow portion of the tube or pipe.

41. A method according to Claim *40*, wherein the securing member *is* moved between the first and second positions by way of rotating a screw.

42. A method of releasably securing a connector within the hollow portion of a tube or pipe, substantially as hereinbefore described, with reference to Figures 1 to 3, 4, 5 and 6, 7, 8 and 9, 10, *11 to 14, 15 and 16, or 17* of the accompanying drawings.

43. Any novel feature or combination of features described herein.

The Patent Office

INVESTOR IN PEOPLE

44

Application No: GB 9821409.1 **Examiner:** Gareth Prothero
Claims searched: 1 to 42 **Date of search:** 3 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F2G (G24D, GRX); F2M MC1; E2A (AGLC, AGLD)

Int Cl (Ed.7): F16B 7/04, 12/40, 29/00

Other: Online: WPI, EPODOC, PAJIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 992542 A	(GERMAIN) see figs 1 and 5.	1, 40 & 41
X	US 4422794 A	(DEKEN) see abstract, and fig 2.	1 & 40
X	US 4344719 A	(THOM) see abstract, and fig 1.	1, 40 & 41

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.